GUIDE FOR READING ELIGIBLE PROFESSIONAL (EP) AND ELIGIBLE HOSPITAL (EH) EMEASURES

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CMS
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Acknowledgments

This document was originally developed by the National Quality Forum (NQF, www.qualityforum.org) under contract with the U.S. Department of Health and Human Services to promote the effective use of Electronic Health Record (EHR) systems and released in October, 2010. It was subsequently updated by NQF, Lantana Consulting Group and the Health Services Advisory Group (HSAG), under contract with the Centers for Medicare and Medicaid Services (CMS). The structural/format changes to the eMeasures which are seen by the end user that have occurred since the October, 2010 document are included in the Summary of Changes section.

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Introduction

Collecting and reporting accurate, comparable healthcare performance data has historically been a complex and time consuming manual process. Performance measures most frequently address data that is routinely available. Claims data, laboratory results and pharmaceutical usage data have traditionally been the source of information for these measures despite the fact that much of the information required for performance measurement is available in electronic health records (EHRs). Performance data from EHRs has not been routinely available for export and use to compute measures. The Medicare and Medicaid EHR Incentive Program (Meaningful Use, Stage 2) is working to reduce the burden of collecting and reporting healthcare performance data by utilizing the capabilities of EHRs.

This document provides guidance for understanding and using the electronically specified eligible professional (EP) and eligible hospital (EH) clinical quality measures ("eMeasures") published in 2012 by the Centers for Medicare and Medicaid Services (CMS) for Meaningful Use, Stage 2.

Using this Guide

This guide should assist providers, chief medical information officers (CMIOs), and quality analysts in interpreting and understanding eMeasures. This applies to electronically respecified paper-based measures and de novo eMeasures. Readers who wish to gain a greater understanding on how to develop and document an eMeasure should also reference the eMeasure Specifications chapter of the *Blueprint for the CMS Measures Management System*.[1]

National Quality Forum Quality Data Model

Truly accessing the rich clinical data residing in EHRs requires that measures are specified to account for the way data are expressed in EHRs. The National Quality Forum (NQF) convened a committee of health IT industry experts, the Health Information Technology Expert Panel (HITEP), to create the Quality Data Model (QDM)—formerly referred to as the Quality Data Set (QDS)—to enable such expression of data requirements in the context of EHR use.[2]

The QDM is an information model that defines concepts that recur across quality measures and clinical care and is intended to enable automation of EHR use. The process of creating an eMeasure involves mapping measure data elements to corresponding QDM components to assemble the data criteria into population criteria within an eMeasure. This process is specified in the eMeasure Specifications chapter of the *Blueprint for CMS Measures Management System*.

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[1] *CMS Measures Management System Blueprint ("Blueprint")*. Available at: https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/MMS/MeasuresManagementSystemBlueprint.html.
[2] *National Quality Forum (NQF) Quality Data Model (QDM), 2011*. Available at: http://www.qualityforum.org/QualityDataModel.aspx#t=1&s=&p=

Health Quality Measure Format

To further enable electronic measurement of EHR data, the NQF, under contract with the U.S. Department of Health and Human Services (HHS), supported the development of a Health Level Seven (HL7) standard known as the Health Quality Measures Format (HQMF) for representing a health quality measure as an electronic Extensible Markup Language (XML) document.[3] A health quality measure encoded in HQMF is referred to as an "eMeasure." Through standardization of a measure's structure, metadata, definitions, and logic, the HQMF provides for quality measure consistency and unambiguous interpretation. HQMF is a component of a larger quality end-to-end framework in which providers will ideally be able to push a button and import these eMeasures into their EHRs. The eMeasures can be turned into queries that automatically query the EHR's data repositories and generate reports for quality reporting. From there, individual and/or aggregate patient quality data can be transmitted to the appropriate agency.

While Release 2 of the HQMF standard is slated to undergo HL7 ballot beginning in September, 2012, this guide applies to eMeasures that are authored based on the HQMF standard, Release 1.

This guide is focused on assisting readers to understand and interpret an eMeasure through dissecting its human-readable rendition format; those who wish to gain a greater understanding of the HQMF syntax should reference the HQMF, Release 1, standard itself.

Measure Authoring Tool

Under contract with HHS, NQF has developed a web-based Measure Authoring Tool (MAT), a software authoring tool that measure developers use to create eMeasures. The authoring tool has been publicly available through NQF since September 27, 2011. The authoring tool allows measure developers to create their eMeasures in a highly structured format using the QDM and healthcare industry standard vocabularies. All Meaningful Use Stage 2 eMeasures are authored in and exported from the MAT. Readers who wish to learn how to use the MAT to author eMeasures should reference the NQF's Measure Authoring Tool User Guide.[4] In late fall 2012, NQF will transition the day-to-day operation of the MAT to HHS.

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[3] *HL7 Version 3 Standard: Representation of the Health Quality Measures Format (eMeasure), Release 1* – September 2009 Ballot. http://www.hl7.org/dstucomments/index_expired.cfm

[4] National Quality Forum's Measure Authoring Tool. https://mat.qualityforum.org/Login.html

eMeasure Components

An eMeasure created in the MAT is exported as a package. Each eMeasure package contains two files and an XML Stylesheet Language for Transformations (XSLT) subfolder. Each of these components helps to view and understand the eMeasure:

- **eMeasure XML file**: An XML document (.xml) based on the HQMF. Its major components include a Header and a Body. The Header identifies and classifies the document and provides important metadata about the measure. The HQMF Body contains eMeasure sections, e.g., data criteria, population criteria, and supplemental data elements.
- **eMeasure human-readable rendition**: A HyperText Markup Language (HTML) file (.html) that displays the eMeasure content in a human-readable format directly in a web browser. This file does not include the underlying HQMF syntax.
- **eMeasure style sheet:** An XML Style Sheet (XSL) file (.xsl), contained in the 'xslt' subfolder, allows the eMeasure XML file to open directly in a web browser. When opened this way, the eMeasure XML file displays in the same human-readable format as the eMeasure human-readable HTML file.

eMeasure value sets are an important piece of an eMeasure. An eMeasure value sets spreadsheet is no longer generated as part of an eMeasure package. Value sets information will be available from the online Value Set Authority Center established by the National Library of Medicine (NLM).[5]

eMeasure File Naming Conventions

The eMeasure naming conventions are described below in the order that they are viewed when accessing the MU2 measures.

Measure Packaging by Setting

There are two "All measures Zip files" for MU2: one for eligible professional (EP) and one for eligible hospital (EH) measures. Each Zip file contains all of the respective eMeasures—29 EH and 64 EP. The files are labeled with the setting followed by the publication date (format: yyyy_mm_dd). Examples:
- **EH_Hospital_eMeasures_2012_10_25.zip**
- **EP_Professional_eMeasures_2012_10_25.zip**

CMS eMeasure Identifier

CMS created a unique "CMS eMeasure Identifier" to clearly and consistently identify eMeasure files. It combines the eMeasure identifier assigned to the eMeasure in the MAT with the "eMeasure

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[5] Value Set Authority Center, National Library of Medicine. http://vsac.nlm.nih.gov

Version Number", which is prepended by "CMS". Based on this universal naming convention, EP measure (NQF0056) would display the following: **CMS123v1**.

eMeasure Information	Value
eMeasures Identifier (MAT)	123
eMeasure Version Number	1
CMS eMeasure ID	**CMS123v1**

Measure Zip File and Folder

The naming conventions for the individual eMeasure packages (zip files and measure folder) that contain the eMeasure XML file, and human-readable rendition are described below in the order in which they appear.

1. Setting for which the measure applies—"EP" or "EH" measures
2. CMS eMeasure ID (as described above)
3. NQF identifier—if not endorsed by NQF, the file will contain "NQFXXXX"
4. Abbreviated name for the clinical quality measure (example: "Diab_Foot")

Using the EP measure example from above for NQF0056, the Zip file and corresponding folder would appear as follows:

Type of Artifact	File Name
Measure Zip file	**EP_CMS123v1_NQF0056_Diab_Foot.zip**
Measure folder	**EP_CMS123v1_NQF0056_Diab_Foot**

Individual eMeasure File Components

The file type (.xml or .html) is added to the CMS eMeasure ID to complete the naming convention for the components of the eMeasure package. Examples below:

Type of Artifact	File Name
HQMF (XML file)	**CMS123v1.xml**
HQMF (HTML file)	**CMS123v1.html**
HQMF (XSL file)	**eMeasure.xsl**

Opening eMeasure Documents

Download, extract, and access eMeasure documents

To view an individual eMeasure, the specification package (example: EP_CMS123v1_NQF0056_Diab_Foot.zip) must be saved and extracted to your computer.

1. Download and save the zip file to your hard drive.

2. Right click on the zip file and select "extract all."

3. Identify the destination where the extract files should be saved and select "extract."

4. Navigate to the new folder containing the extracted files.

To view the XML coding directly, open the document with either any text reader such as Word, Wordpad, or Notepad or any third party XML reading software.

It is important that the folder structure not be altered after the files are extracted. Due to the eMeasure style sheet that is contained in the xslt folder, opening the eMeasure XML file in a web browser will display it in the same human-readable format as the eMeasure human-readable HTML file. To open in a text editor or an XML editor, right click on the file and select "Open with," then select the text editor or XML editor of your choice.

Understanding an eMeasure Human-Readable Rendition

The eMeasure human-readable rendition contains a **header** and further measure detail divided into four sections: **population criteria, data criteria, reporting stratification,** and **supplemental data elements.** Continuous variable measures will also contain a **measure observations** section.

Header

The header of an eMeasure identifies and classifies the document and provides important metadata about the measure. The eMeasure header precedes the measure details. It includes the following components (listed in the order that they are displayed in Figure 1):

eMeasure Title: The title of the quality eMeasure.

eMeasure Identifier (Measure Authoring Tool): A unique eMeasure identifier that is automatically generated by the NQF-developed MAT.

eMeasure Version Number: A positive integer value used to indicate the version of the eMeasure.

NQF Number: Specifies the NQF number if one has been assigned. An NQF number is only included if an eMeasure is endorsed. The assigned NQF number can be cross-referenced with NQF's Quality Positioning System (QPS)[6] to verify measure endorsement status.

GUID: Represents the globally unique measure identifier for a particular quality eMeasure. This field is automatically generated by the NQF-developed MAT.

Measurement Period: The time period for which the eMeasure applies.

Measure Steward: The organization responsible for the continued maintenance of the eMeasure. The measure steward can be the same as the measure developer.

Measure Developer: The organization that developed the eMeasure.

Endorsed By: The organization that has endorsed the eMeasure through a consensus-based process. All endorsing organizations are to be included.

Description: A general description of the eMeasure intent.

Copyright: Identifies the organization(s) who own the intellectual property represented by the eMeasure.

Disclaimer: Disclaimer information for the eMeasure.

Measure Scoring: Indicates how the calculation is performed for the eMeasure (e.g., proportion, continuous variable, or ratio).

Measure Type: Indicates whether the eMeasure is used to examine a process or an outcome over time (e.g., structural, process, or outcome measure).

Stratification: Describes the strata for which the measure is to be evaluated. There are several reasons for stratification, including: (1) evaluate the measure based on different age groupings within the population described in the measure; (2) evaluate the eMeasure based on either a specific condition, a

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[6] *http://www.qualityforum.org/Home.aspx*

specific discharge location, or both; (3) evaluate the eMeasure based on different locations within a facility.

Risk Adjustment: The method of adjusting for clinical severity and conditions present at the start of care that can influence patient outcomes for making valid comparisons of outcome measures across providers. Risk adjustment indicates whether an eMeasure is subject to the statistical process for reducing, removing, or clarifying the influences of confounding factors to allow more useful comparisons.

Rate Aggregation: Describes how to combine information calculated based on logic in each of several populations into one summarized result. It can also be used to describe how to risk adjust the data based on supplemental data elements described in the eMeasure.

Rationale: Succinct statement of the need for the measure. Usually includes statements pertaining to importance criterion: impact, gap in care, and/or evidence.

Clinical Recommendation Statement: Summary of relevant clinical guidelines or other clinical recommendations supporting the eMeasure.

Improvement Notation: Information on whether an increase or decrease in score is the preferred result (e.g., a higher score indicates better quality OR a lower score indicates better quality OR quality is within a range).

Reference(s): Identifies bibliographic citations or references to clinical practice guidelines, sources of evidence, or other relevant materials supporting the intent and rationale of the eMeasure.

Definition: Description of individual terms, provided as needed.

Guidance: Used to allow measure developers to provide additional guidance for implementers to understand greater specificity than could be provided in the logic for data criteria.

Transmission Format: Can be a URL or hyperlinks that link to the transmission formats that are specified for a particular reporting program.

Initial Patient Population: Refers to all patients to be evaluated by a specific performance eMeasure who share a common set of specified characteristics within a specific measurement set to which a given measure belongs. Details often include information based upon specific age groups, diagnoses, diagnostic and procedure codes, and enrollment periods.

Denominator: The denominator can be the same as the initial patient population or a subset of the initial patient population to further constrain the population for the purpose of the eMeasure. Different measures within an eMeasure set may have different Denominators. Continuous Variable eMeasures do not have a Denominator, but instead define a Measure Population.

Denominator Exclusions: Patients who should be removed from the eMeasure population and denominator before determining if numerator criteria are met. Denominator exclusions are used in proportion and ratio measures to help narrow the denominator.

Numerator: Numerators are _used in proportion and ratio eMeasures_. In proportion measures, the numerator criteria are the processes or outcomes expected for each patient, procedure, or other unit of measurement defined in the denominator. In ratio measures, the numerator is related, but not directly derived from the denominator (e.g., a numerator listing the number of central line blood stream infections and a denominator indicating the days per thousand of central line usage in a specific time period).

Numerator Exclusions: Numerator Exclusions are _used only in ratio eMeasures_ to define instances that should not be included in the numerator data. (e.g., if the number of central line blood stream

infections per 1000 catheter days were to exclude infections with a specific bacterium, that bacterium would be listed as a numerator exclusion.)

Denominator Exceptions: Denominator exceptions are those conditions that should remove a patient, procedure or unit of measurement from the denominator only if the numerator criteria are not met. Denominator exceptions allow for adjustment of the calculated score for those providers with higher risk populations. Denominator exceptions are *used only in proportion eMeasures*. They are not appropriate for ratio or continuous variable eMeasures.

Denominator exceptions allow for the exercise of clinical judgment and should be specifically defined where capturing the information in a structured manner fits the clinical workflow. Generic denominator exception reasons used in proportion eMeasures fall into three general categories:

- Medical reasons
- Patient reasons
- System reasons.

Measure Population: Measure population *is used only in continuous variable eMeasures*. It is a narrative description of the eMeasure population (e.g., all patients seen in the Emergency Department during the measurement period).

Measure Observations: Measure observations are *used only in continuous variable eMeasures*. They provide the description of how to evaluate performance (e.g., the mean time across all Emergency Department visits during the measurement period from arrival to departure). Measure observations are generally described using a statistical methodology such as: count, median, mean, etc.

Supplemental Data Elements: CMS defines four required Supplemental Data Elements (payer, ethnicity, race, and sex), which are variables used to aggregate data into various subgroups. Comparison of results across strata can be used to show where disparities exist or where there is a need to expose differences in results. Additional supplemental data elements required for risk adjustment or other purposes of data aggregation can be included in the Supplemental Data Element section.

Figure 1: eMeasure Header for Diabetes: Foot Exam (NQF 0056)

eMeasure Title	Diabetes: Foot Exam		
eMeasure Identifier (Measure Authoring Tool)	123	eMeasure Version Number	1
NQF Number	0056	GUID	c0d72444-7c26-4863-9b51-8080f8928a85
Measurement Period	January 1, 20xx through December 31, 20xx		
Measure Steward	National Committee for Quality Assurance		
Measure Developer	National Committee for Quality Assurance		
Endorsed By	National Quality Forum		
Description	Percentage of patients 18-75 years of age with diabetes who had a foot exam during the measurement period		
Copyright	Physician Performance Measure (Measures) and related data specifications were developed by the National Committee for Quality Assurance (NCQA). The Measures are copyrighted but can be reproduced and distributed, without		

	modification, for noncommercial purposes (e.g., use by healthcare providers in connection with their practices). Commercial use is defined as the sale, licensing, or distribution of the Measures for commercial gain, or incorporation of the Measures into a product or service that is sold, licensed or distributed for commercial gain. Commercial use of the Measures requires a license agreement between the user and NCQA. NCQA is not responsible for any use of the Measures. Copyright 2012 National Committee for Quality Assurance. All Rights Reserved. Limited proprietary coding is contained in the Measure specifications for user convenience. Users of proprietary code sets should obtain all necessary licenses from the owners of the code sets. NCQA disclaims all liability for use or accuracy of any CPT or other codes contained in the specifications. CPT(R) contained in the Measure specifications is copyright 2004-2011 American Medical Association. LOINC(R) copyright 2004-2011 Regenstrief Institute, Inc. This material contains SNOMED Clinical Terms (R) (SNOMED CT[R]) copyright 2004-2011 International Health Terminology Standards Development Organization. ICD-10 copyright 2011 World Health Organization. All Rights Reserved. Due to technical limitations, registered trademarks are indicated by (R) or [R] and unregistered trademarks are indicated by (TM) or [TM].
Disclaimer	These performance Measures are not clinical guidelines and do not establish a standard of medical care, and have not been tested for all potential applications. THE MEASURES AND SPECIFICATIONS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND.
Measure Scoring	Proportion
Measure Type	Process
Stratification	None
Risk Adjustment	None
Rate Aggregation	None
Rationale	Diabetes mellitus (diabetes) is a group of diseases characterized by high blood glucose levels caused by the body's inability to correctly produce or utilize the hormone insulin. It is recognized as a leading cause of death and disability in the U.S. and is highly underreported as a cause of death. Diabetes of either type may cause life-threatening, life-ending or life-altering complications, including poor circulation, nerve damage or neuropathy in the feet and eventual amputation. Nearly 60%-70% of diabetics suffer from mild or severe nervous system damage. The consensus among established clinical guidelines is that patients with both types of diabetes should have a foot exam soon after diagnosis and annually thereafter. Comprehensive foot care programs can lower amputation rates by 45%-85% (American Diabetes Association, 2009).
Clinical Recommendation Statement	American Diabetes Association (ADA, 2009) Guidelines/ Recommendations: Perform annual comprehensive foot examination to identify risk factors predictive of ulcers and amputations. The foot examination should include inspection, assessment of foot pulses, and testing for loss of protective sensation (10-g monofilament plus testing any one of: vibration using 128-Hz tuning fork, pinprick sensation, ankle reflexes, or vibration perception threshold).
Improvement Notation	Higher score indicates better quality
Reference	American Diabetes Association. Executive Summary: Standards of Medical Care in Diabetes-2009. Diabetes Care January 2009 32:S6-S12; doi:10.2337/dc09-S006
Definition	Foot exam: visual inspection with either a sensory exam or a pulse exam
Guidance	Only patients with a diagnosis of Type 1 or Type 2 diabetes should be included in the

	denominator of this measure; patients with a diagnosis of secondary diabetes due to another condition should not be included.
Transmission Format	None
Initial Patient Population	Patients 18-75 years of age with diabetes and a visit during the measurement period
Denominator	Equals Initial Patient Population
Denominator Exclusions	Patients with a diagnosis of gestational diabetes during the measurement period
Numerator	Patients who received a foot exam (visual inspection with either a sensory exam or pulse exam) during the measurement period
Numerator Exclusions	Not Applicable
Denominator Exceptions	None
Measure Population	Not Applicable
Measure Observations	Not Applicable
Supplemental Data Elements	For every patient evaluated by this measure also identify payer, race, ethnicity and sex.

## Data Criteria (QDM Data Elements)

Data criteria are used as building blocks to assemble population criteria; hence, it is important to first understand how to interpret a data criterion. The Data Criteria section of the eMeasure human-readable rendition lists all unique QDM elements used by a measure in alphabetical order.

QDM Element

A QDM element is an atomic unit of information corresponding to a data criterion in an eMeasure. If quality data attributes are used to further specify a QDM element, then these attributes are also displayed in the Data Criteria section following all the QDM elements.

As shown in Figure 2, a QDM element is specified by selecting (1) a QDM category, (2) the state in which the category is expected to be found with respect to electronic clinical data, (3) a value set from an appropriate vocabulary, and (4) all required attributes. A QDM category is a particular group of information that can be addressed in a quality measure (e.g., condition, medication, procedure, etc.). The combination of category and state makes up a quality data type. For Meaningful Use Stage 2 measures, readers should reference the specification for QDM 2.1.1.1 published by the NQF for complete technical details of the QDM, such as definitions for all its quality data types and attributes.

Figure 2: Prototypic Quality Data Element
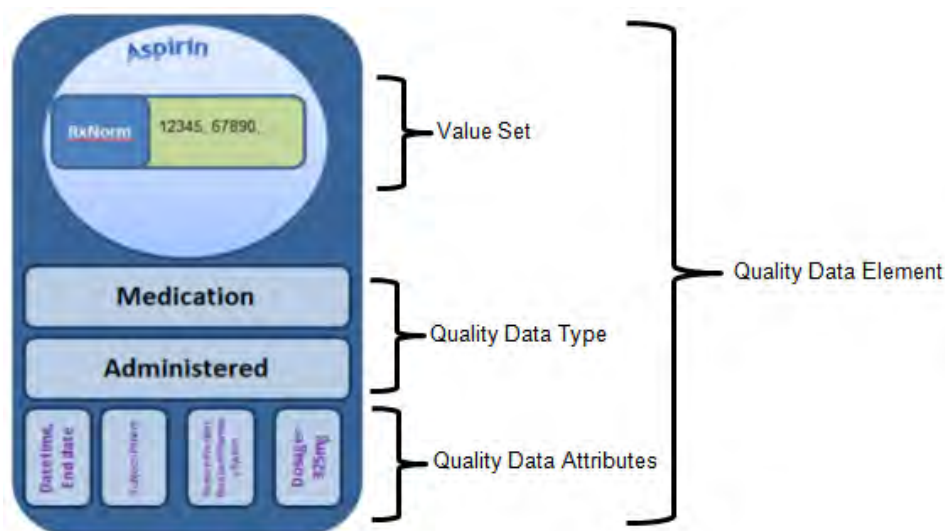
All QDM elements in an eMeasure human-readable conform to the following naming convention: *"QDM_quality_data_type*: *measure_data_element_name".* For example, to create the QDM element "Diagnosis, Active: Diabetes" as shown in Figure 3, a measure developer needs to first map the measure data element *Diabetes* to the correct QDM category, which is *Diagnosis*, then apply the correct state, *Active*, based on the measure. The next step is to specify a *Diabetes* value set and associate it to the "Diagnosis, Active" quality data type.

Figure 3: eMeasure Data Criteria - Diabetes: Foot Exam (NQF 0056)

Data criteria (QDM Data Elements)

- "Diagnosis, Active: Diabetes" using "Diabetes Grouping Value Set (2.16.840.1.113883.3.464.1003.103.12.1001)"
- "Diagnosis, Active: Gestational Diabetes" using "Gestational Diabetes Grouping Value Set (2.16.840.1.113883.3.464.1003.103.12.1010)"
- "Encounter, Performed: Annual Wellness Visit" using "Annual Wellness Visit Grouping Value Set (2.16.840.1.113883.3.526.3.1240)"
- "Encounter, Performed: Face-to-Face Interaction" using "Face-to-Face Interaction Grouping Value Set (2.16.840.1.113883.3.464.1003.101.12.1048)"
- "Encounter, Performed: Home Healthcare Services" using "Home Healthcare Services Grouping Value Set (2.16.840.1.113883.3.464.1003.101.12.1016)"
- "Encounter, Performed: Office Visit" using "Office Visit Grouping Value Set (2.16.840.1.113883.3.464.1003.101.12.1001)"
- "Encounter, Performed: Preventive Care Services - Established Office Visit, 18 and Up" using "Preventive Care Services - Established Office Visit, 18 and Up Grouping Value Set (2.16.840.1.113883.3.464.1003.101.12.1025)"
- "Encounter, Performed: Preventive Care Services-Initial Office Visit, 18 and Up" using "Preventive Care Services-Initial Office Visit, 18 and Up Grouping Value Set (2.16.840.1.113883.3.464.1003.101.12.1023)"
- "Patient Characteristic Birthdate: birth date" using "birth date LOINC Value Set (2.16.840.1.113883.3.560.100.4)"
- "Physical Exam, Performed: Pulse Exam of Foot" using "Pulse Exam of Foot Grouping Value Set (2.16.840.1.113883.3.464.1003.103.12.1015)"
- "Physical Exam, Performed: Sensory Exam of Foot" using "Sensory Exam of Foot Grouping Value Set (2.16.840.1.113883.3.464.1003.103.12.1014)"
- "Physical Exam, Performed: Visual Exam of Foot" using "Visual Exam of Foot Grouping Value Set (2.16.840.1.113883.3.464.1003.103.12.1013)"

Value Set

A value set is a set of concept representations drawn from a single or multiple code systems. Each value set can be uniquely identified by the Object Identifier (OID) that is assigned. In the eMeasure human-readable rendition, value sets are referred to by both a name (*value_set_name*) *and identifier* (*value_set_OID*). The use of a given value set in an eMeasure is indicated by "**using** '*value_set_name* (*value_set_OID*)'". . For example, "'Diagnosis, Active: Diabetes' using 'Diabetes Grouping Value Set (2.16.840.1.113883.3.464.3.3.2.1)'", where 2.16.840.1.113883.3.464.3.3.2.1 is the OID for the value set that is named "Diabetes".

There are two types of value sets: regular value sets and grouping value sets. eMeasures created in the MAT list the value sets using the following convention:

1. "*value_set_name code_system_name* **Value Set**" (e.g., birth date LOINC Value Set). This indicates the value set contains a single code or an enumerated list of codes from a single code system. Details of the value set can be found in the Value Set Authority Center from NLM.

2. "*value_set_name* **Grouping Value Set**" (e.g., Diabetes Grouping Value Set). The word "Grouping" indicates the value set is a grouping value set. A grouping value set is a collection of individual value sets representing the same measure data element in different code system. For example, codes for diabetes from SNOMED CT and ICD-10-CM. The constituent individual value sets are also identified by their OIDs; but they are not specifically listed in the Data Criteria section, where the OID of the grouping value set is listed instead. Details for grouping value sets and their constituent individual value sets can also be found in the Value Set Authority Center.

To improve value set authorship, curation, and delivery, for Meaningful Use Stage 2, NLM has performed quality assurance checks to assess the validity of value set codes, terms and associated vocabularies. NLM will support ongoing maintenance of controlled value sets through a publicly available authoritative repository, the Value Set Authority Center. In the future, NLM will develop author support tools and validation services.

QDM Attribute

Figure 4Figure 4 shows an example of an attribute in the Data Criteria section. Only coded attributes that are bound to a value set are listed in the Data Criteria section. The naming convention for listing an attribute is '**Attribute:** "*QDM_attribute***:** *value_set_name*"'. The label "Attribute" indicates this is an attribute to a QDM element, but the association between the attribute and the QDM element is shown in the Population Criteria section. In this example, the attribute *Ordinality* is bound to the "Principal SNOMED-CT Value Set" that is identified by the OID "2.16.840.1.113883.3.117.1.7.1.14".

Figure 4: eMeasure Data Criteria - Attribute Example

> • Attribute: "Ordinality: Principal" using "Principal SNOMED-CT Value Set (2.16.840.1.113883.3.117.1.7.1.14)"

Population Criteria

Population criteria are assembled from the underlying data criteria. The populations that are applicable for a particular measure depend on the type of measure scoring. The value of the "measure scoring" header element indicates whether this eMeasure is a proportion, ratio, or continuous variable measure. Definitions for each population and measure observations are listed in the Header section of this guide.

- **Proportion measures:** Measures that define quality based on the number of cases that meet a criterion for quality (the numerator) divided by the number of eligible cases within a given time frame (the denominator).
- **Continuous variable measures:** Measures that define quality based on variables amongst the patients in the defined population (e.g. based on average wait time for patients seen in the emergency department and subsequently admitted to the hospital).
- **Ratio measures:** Measures that define quality based on the ratio of two events (e.g., number of patients with central line infection divided by number of patients in the intensive care unit).

Proportion is the most common used measure scoring type for the Meaningful Use Stage 2 measures.

Figure 5 shows the population criteria for a proportion measure: Diabetes: Foot Exam (NQF 0056). It contains initial patient population, denominator, denominator exclusions, numerator, and denominator exceptions. If the denominator exclusions and denominator exceptions are not applicable to a particular proportion measure, a "None" is displayed.

Figure 5: eMeasure Population Criteria - Diabetes: Foot Exam (NQF 0056)

Population criteria

- **Initial Patient Population =**
    - AND: "Diagnosis, Active: Diabetes" starts before or during "Measurement Period"
    - AND: "Patient Characteristic Birthdate: birth date" >= 18 year(s) starts before start of "Measurement Period"
    - AND: "Patient Characteristic Birthdate: birth date" <= 75 year(s) starts before start of "Measurement Period"
    - AND:
        - OR: " Encounter, Performed: Office Visit"
        - OR: " Encounter, Performed: Face-to-Face Interaction"
        - OR: "Encounter, Performed: Preventive Care Services - Established Office Visit, 18 and Up"
        - OR: "Encounter, Performed: Preventive Care Services-Initial Office Visit, 18 and Up"
        - OR: "Encounter, Performed: Home Healthcare Services"
        - OR: "Encounter, Performed: Annual Wellness Visit"
        - during "Measurement Period"
- **Denominator =**
    - AND: "Initial Patient Population"
- **Denominator Exclusions =**
    - AND: "Diagnosis, Active: Gestational Diabetes" during "Measurement Period"
- **Numerator =**
    - AND:
        - AND: "Physical Exam, Performed: Visual Exam of Foot"
        - AND:
            - OR: "Physical Exam, Performed: Sensory Exam of Foot"
            - OR: "Physical Exam, Performed: Pulse Exam of Foot"
        - during "Measurement Period"
- **Denominator Exceptions =**
    - None

Understanding Logic Descriptions within the Population Criteria

Boolean Operators (AND and OR): ANDs and ORs are used to assemble data criteria to form population criteria. Appropriate temporal context and comparators such as "starts before or during" and relative comparators such as "first" and "last" can also be used to form a population criterion measure phrase. The AND operator means all elements joined by the AND have to be true for consideration by the measure. The OR operator means any one element has to be true for consideration by the measure.

The following summary depicts the meaning of AND and OR operators contained in Figure 6 below.

The patient must have an active diagnosis of diabetes that started prior to or during the measurement period, and must be greater than or equal to 18 years of age, prior to the measurement period, and younger than or equal to 75 years of age prior to the measurement period, and have one of the following during the measurement period: either an office visit encounter, or a face-to-face interaction, or an encounter for preventive services as an established patient, or an encounter for initial preventive care services, or an encounter for home healthcare services, or an encounter for an annual wellness visit.

Figure 6: eMeasure Initial Patient Population Logic Description - Diabetes: Foot Exam (NQF 0056)
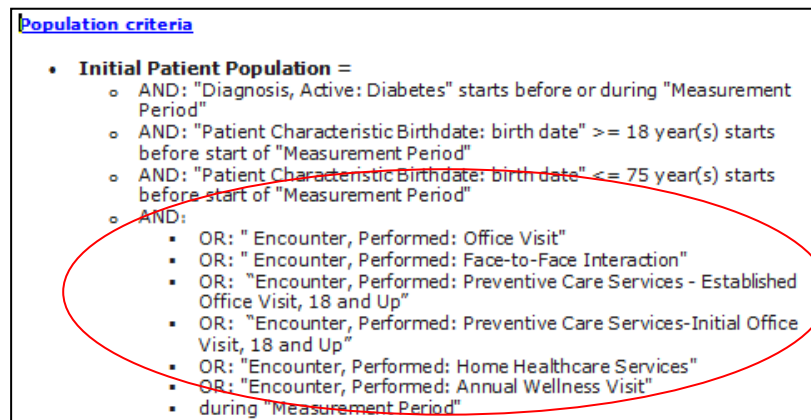
Criteria Nesting: Population criteria can be a simple flat list of measure phrases, or a set of measure phrases that could be deeply nested. There are two types of nesting that are represented in an eMeasure human-readable through using either indentation or parentheses.

> **Indentation:** Indents are used to show items that are grouped together. Measure phrases that are on the same level of indentation should be evaluated together as a group. Where the nesting exists, the lowest level should be evaluated first, and then move to the outside next immediate upper indentation level. In Figure 6 above, the circled portion indicates that if the patient had an instance of any one of the encounter types contained in this list, then they satisfy the criterion when calculating the initial patient population. The phrase "during 'Measurement Period'" at the bottom of this indented list applies to each measure phrase in the group, which will read the same as "OR: 'Encounter, Performed: Office Visit' during 'Measurement Period'".

> **Parentheses:** Multiple measure phrases may be joined in one logic statement by a series of relationship types (e.g., starts before the start of) and timeframes (e.g.,<=10 months). Parentheses are used to clarify which elements, time relationship, and timeframe belong to which phrase, similar to how parentheses are used in mathematical equations. As a result, at the end of one statement there may be one or more parentheses. Careful examination of the statement will reveal the nested phrases and time relationship to which the parenthesis belongs—e.g., "'A" starts before start of ("B" during "C")' or "'A" <= 2 day(s) ends after end of ("B" during "C")'.

Logical Function - NOT: NOT is a logical function of the QDM. It negates a QDM element with its associated attribute(s) or phrase. It can be used together with the Boolean operators to form an "AND NOT" or an "OR NOT". Figure 7 shows two examples of population criteria where NOT is used. To illustrate, in Example 1, instead of saying that the patient must have an active principal diagnosis of Venous Thromboembolism (VTE) during the inpatient encounter; the NOT logical

function has negated the entire measure phrase to mean the patient must not have an active principal diagnosis of VTE during the inpatient encounter.

Figure 7: eMeasure Population Criteria - NOT Logical Function Example

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Example 1:

- AND NOT: "Diagnosis, Active: Venous Thromboembolism (ordinality: 'Principal Diagnosis')" during "Encounter, Performed: Inpatient Encounter"

Example 2:

- OR NOT:
    - AND: "Diagnostic Study, Performed: VTE Diagnostic Test" starts before or during "Encounter, Performed: Inpatient Encounter"
    - AND: "Diagnostic Study, Result: VTE Confirmed" starts after start of "Encounter, Performed: Inpatient Encounter"

QDM Attributes: A QDM attribute is shown in a parenthesis immediately after the QDM element that it is associated with. For example, *ordinality* is an attribute to the *Diagnosis, Active* as shown in Figure 7. The *ordinality* is a coded attribute, and is bound to a value set for "Principal Diagnosis". Not all attributes are coded attributes; a measure may contain attributes such as *discharge datetime* and *length of stay* for an encounter, e.g., "Encounter, Performed: Inpatient Encounter (discharge datetime)" and "Encounter, Performed: Inpatient Encounter (length of stay <= 120 day(s))". Readers should reference the National Quality Forum's *Quality Data Model* for the complete list of attributes and their definitions, and reference the *Measure Authoring Tool User Guide*[7] to see what attributes apply to a specific QDM quality data type.

Measurement Period/Start Date/End Date: Measurement period, measurement start date, and measurement end date are the three QDM elements that are not listed in the Data Criteria section. They are defined in the measure header, and could be used in the population criteria.

Relative Timings: Allow a measure developer to describe timing relationships among individual QDM elements to create clauses that add meaning to the individual QDM elements. Relative timings are described in detail in the *Quality Data Model*.[7] There are fourteen time relationships that are available for use by a measure in the MAT:

- concurrent with
- during
- ends after end of
- ends after start of
- ends before or during
- ends before start of

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[7] *Measure Authoring Tool User Guide can be downloaded by clicking the "User Guide" link on the Measure Authoring Tool login page.* *https://mat.qualityforum.org/Login.html*

- ends concurrent with
- ends during
- starts after end of
- starts after start of
- starts before or during
- starts before start of
- starts concurrent with
- starts during

When a time relationship is used to connect two QDM elements, the QDM element on the left side of the time relationship is regarded as the source act and the QDM on the right side as the target act. A measure phrase "'A" starts before or during "B'" means the effective time of "A" starts before the start of "B" or starts during "B"'s effective time.

Occurrence of a QDM Element: A QDM element can be referenced several times in a measure and represent one to many episodes or occurrences of that element (e.g., if a measure references more than one encounter, it will distinguish between **Occurrence A of Encounter** and **Occurrence B of Encounter**). To differentiate to the reader if each episode of that element is the same as or different from a prior episode referenced elsewhere in the measure, a label of "Occurrence" can be placed before the element.

Other Data Relationships: A data element in a measure can be associated with other data elements to provide more clarity. These relationships include "Is Authorized By" (used to express that a patient has provided consent); "Is Derived By" (used to indicate a result that is calculated from other values); "Has Goal Of" (used to relate a Care Goal to a procedure); "Causes" (used to relate causality); and "Has Outcome Of" (used to relate an outcome to a procedure as part of a care plan).

Measure Set: Located at the very bottom of an eMeasure human-readable rendition, it indicates which measure set this measure belongs to. For example, "Measure Set: Surgical Care Improvement Project (SCIP)" means this measure is part of the Surgical Care Improvement Project measure set. This designation only applies to hospital measures in the EHR Incentive Program; eligible professional measures do not use measure sets.

Reporting Stratification

Measure developers may define Reporting Strata, which are variables on which the measure is designed to report inherently (e.g., report different rates by type of intensive care unit in a facility; stratify and report separately by age group [14-19, 20-25, and total 14-25]).

The Reporting Stratification section is always included in an eMeasure human-readable rendition. If a measure does not have reporting strata defined, "None" is displayed as the default.

If a measure contains reporting stratification, each of the reporting strata is listed separately under its own heading, as shown in Figure 8 (example from the hospital measure NQF0143, *children's asthma care (CAC-1) relievers for inpatient asthma*). Similar rules that are described above under the *Understanding Logic Descriptions within the Population Criteria* section of this guide also apply when interpreting a reporting stratum.

Figure 8: Reporting Stratification Example

- **Reporting Stratum 1 =**
  - AND: "Patient Characteristic Birthdate: birth date" >= 2 year(s) starts before start of "Encounter, Performed: Inpatient Encounter"
  - AND: "Patient Characteristic Birthdate: birth date" <= 4 year(s) starts before start of "Encounter, Performed: Inpatient Encounter"
- **Reporting Stratum 2 =**
  - AND: "Patient Characteristic Birthdate: birth date" >= 5 year(s) starts before start of "Encounter, Performed: Inpatient Encounter"
  - AND: "Patient Characteristic Birthdate: birth date" <= 12 year(s) starts before start of "Encounter, Performed: Inpatient Encounter"
- **Reporting Stratum 3 =**
  - AND: "Patient Characteristic Birthdate: birth date" >= 13 year(s) starts before start of "Encounter, Performed: Inpatient Encounter"
  - AND: "Patient Characteristic Birthdate: birth date" < 18 year(s) starts before start of "Encounter, Performed: Inpatient Encounter"
- **Reporting Stratum 4 =**
  - AND: "Patient Characteristic Birthdate: birth date" >= 2 year(s) starts before start of "Encounter, Performed: Inpatient Encounter"
  - AND: "Patient Characteristic Birthdate: birth date" < 18 year(s) starts before start of "Encounter, Performed: Inpatient Encounter"

Supplemental Data Elements

CMS defines Supplemental Data Elements which are variables used to aggregate data into various subgroups. Comparison of results across strata can be used to show where disparities exist or where there is a need to expose differences in results. CMS specifies that sex, race, ethnicity, and payer are the four supplemental data elements that must be defined in each of the Meaningful Use Stage 2 measures (see Figure 9). Different supplemental data elements can be indicated as mandatory according to different program requirements. For example, Tax Identification Number (TIN), National Provider Identifier (NPI), CMS Certification Number (CCN), and beneficiary claim number (HIC) may be requested as supplemental data elements with additional guidance that will be provided by the program.

Figure 9: Supplemental Data Elements Example

<u>**Supplemental Data Elements**</u>
- "Patient Characteristic Ethnicity: Ethnicity" using "Ethnicity CDC Value Set (2.16.840.1.114222.4.11.837)"
- "Patient Characteristic Sex: Sex" using "ONC Administrative Sex Value Set (2.16.840.1.113762.1.4.1)"
- "Patient Characteristic Payer: Payer" using "Payer Source of Payment Typology Value Set (2.16.840.1.114222.4.11.3591)"
- "Patient Characteristic Race: Race" using "Race CDC Value Set (2.16.840.1.114222.4.11.836)"

Measure Observations

Continuous variable measures also include a Measure Observations section. This section defines variables (e.g. time from check in to time of antibiotic administration) used to score particular aspects of performance. Measure observations are not population criteria, in that they do not determine whether or not a patient is to be counted in a measure. Rather, measure observations are data elements that are to be collected on patients meeting the population criteria within a continuous variable measure. Figure 10 is an example for the Measure Observations section from the hospital measure NQF0495, median time from ED arrival to ED departure for admitted ED patients.

Figure 10: Measure Observations Example

<u>**Measure observations**</u>
- Time difference of:
  - AND: "Encounter, Performed: Emergency Department Visit (facility location arrival datetime)"
  - AND: "Encounter, Performed: Emergency Department Visit (facility location departure datetime)"

eMeasure Value Set

Detailed information for each of the value sets from the MU2 eMeasures will be available through accessing the online Value Set Authority Center hosted by NLM (http://vsac.nlm.nih.gov).

Summary of Changes

The changes to the eMeasures which are seen by the end user that have occurred since October, 2010 are summarized in Table 1.

Table 1: Summary of Changes to eMeasures

	October, 2010	October, 2012
eMeasure Components	eMeasure Specification (pdf) eMeasure Code List (xls)	eMeasure Specification (xml) eMeasure human-readable (html) eMeasure style sheet (xsl) eMeasure value sets available through the Value Set Authority Center.
Software Needed to Open eMeasure	Adobe Acrobat Reader; any spreadsheet reader that understands Microsoft Excel	text reader such as Word, Wordpad, or Notepad or any third party XML reading software
Naming Conventions for Files	NQF_HQMF_HumanReadable_*xxx*.pdf NQF_Retooled_Measure_*xxx*.xls	Please refer to eMeasure Components section
eMeasure Header Data Elements	Header elements found in MU1 measures, but not in MU2 include – set id and available date.	Header elements found in MU2 measures, but not in MU1 include – eMeasure identifier (Measure Authoring Tool), NQF number, transmission format, initial patient population, denominator, denominator exclusions, numerator, numerator exclusions, denominator exceptions, measure population, measure observations, and supplemental data elements.

Acronyms and Abbreviations

CDC	Centers for Disease Control
CMIO	Chief Medical Information Officer
CMS	Centers for Medicare and Medicaid Services
CPT	Current Procedural Terminology
EH	eligible hospital
EHR	electronic health record
EP	eligible professional
GUID	Globally Unique Identifier
HIT	Health information technology
HITSC	Health Information Technology Standards Committee
HL7	Health Level Seven
HTML	HyperText Markup Language
HQMF	Health Quality Measure Format
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
ICD-10-CM	International Classification of Diseases, Tenth Revision, Clinical Modification
LOINC	Logical Observation Identifiers Names and Codes
MAT	Measure Authoring Tool
NCQA	National Committee for Quality Assurance
NLM	National Library of Medicine
NQF	National Quality Forum
OID	object identifier
QDM	Quality Data Model (previously known as Quality Data Set)
QDE	Quality Data Elements
QPS	NQF Quality Positioning System
SNOMED-CT	Systematized Nomenclature of Medicine, Clinical Terms
XML	Extensible Markup Language
XSL	Extensible Stylesheet Language
XLST	Extensible Stylesheet Language Transformations